

## **The Existing Status and Potential Market for Cogeneration in China**

Ladies and gentlemen,

On behalf of this delegation of the Cogeneration Study Committee, I wish to report to you on "The Existing Status and Potential Market for Cogeneration in China".

Since the founding of the People's Republic of China, our government has stressed the importance of cogeneration. Because of this, many regional cogeneration power plants were built when China started its first large-scale economic development in the early 1950s. By 1960, 20% of the thermal power plants with an installed capacity of 0.6 MW or greater were cogeneration plants. This was a high level at that time. Afterwards, the development of cogeneration slowed down due to low efficiencies and an insufficient number of steam users.

Since 1981, the central government has once again started to pay attention to the development of cogeneration for the purpose of saving energy and protecting the environment. Since then, policies have been enacted that encourage the development of cogeneration.

### **I. Existing Status of China's Cogeneration**

#### **A. Characteristics of China's Cogeneration**

With 40 years' experience in developing cogeneration, China has formed its own way of developing combined heat and power technology

- (i). In recent years, most cogeneration power plants have been built in economic and industrial zones to replace

small coal-fired boilers. The efficiency of these power plants is immediate because of the ready access to steam users.

- (ii). Many cities and counties have longer-term cogeneration plans because cogeneration must be developed in conjunction with the larger economic plans of the localities. If the cogeneration project cannot find enough steam users, the project cannot be approved by the related government agencies.
- (iii). Most cogeneration power plants are organized at the local level and include some that are within defense units but provide steam both for their own use and that of the surrounding area.
- (iv). Cogeneration power plants are no longer monopolized by the electric power sector. Now, local governments and enterprises can build their own cogeneration power plants.
- (v). Some old steam turbine power plants built around the year of 1949 have been rebuilt into high efficiency cogeneration power plants to provide steam for the urban areas.
- (vi). In accordance with local heating demands, urban areas need to adopt larger capacity and higher efficiency 200 or 300 MW extracting and condensing cogeneration units. This equipment has flexible performance and can operate efficiently during both heating and non-heating periods. China has already imported some of these large capacity units to replace smaller units.

- (vii). Due to the fast growth of township enterprises in some counties, the need exists to satisfy growing demand for steam and electricity. Consequently, there is a trend toward building county level cogeneration power plants.
- (viii). The economic development zones in various cities use the inclusion of cogeneration power plants as part of their infrastructure to attract investors.
- (ix). The “Air Pollution Protection Law of PRC”, the “Energy Saving Law of PRC”, “China’s 21<sup>st</sup> Century Agenda”, “Energy Saving Administration Temporary Regulations”, the “Energy Saving Technology and Policy Outline” and the “Currently Encouraged Production and Technology List” all support the development of cogeneration. In 1998, the State Development and Planning Commission, the State Economic and Trading Commission, the State Electric Power Ministry, and the State Construction Ministry jointly issued a cogeneration regulation to emphasize the development of cogeneration in China.

B. The Existing Situation of Cogeneration in China.

(i). Cogeneration Units Status at the End of 1998

In China, there are currently 1,313 cogeneration units in excess of 0.6 MW each, which account for 12.7% of total thermal units. They have a total generating capacity of 24,930.85 MW and have the ability to supply 1.036 trillion GJ of steam.

In 1998, some new large capacity cogeneration units were installed. As a result, the average capacity of cogeneration units increased from 12.8 MW/unit to 35.3 MW/unit in 1998.

(ii). Operating Cogeneration Power Plants

Among operating cogeneration power plants, Taiyuan No. 1 Cogeneration Power Plant in Shanxi Province is the largest, with a generating capacity of 1,386 MW. Several large cities including Beijing, Shenyang, Jilin, Changchun, Zhengzhou, Handan, Qinhuangdao, Tianjin and Taiyuan also have 200 MW to 300 MW extracting and condensing steam turbine cogeneration power plants in operation. However, no matter the size, cogeneration power plants are now being built all over the country, even in remote regions. Regional cogeneration power plants have now spreading to rural areas, such as the cogeneration power plant in Suzhou City, and are playing an increasingly important role in the development of those areas.

(iii). Heating Supply Situation

Beijing Thermal Company is the largest of the urban thermal companies and is responsible for providing heat to industry and to commercial and residential areas. There are 8 cogeneration power plants under its administration with 328 km of pipeline and a heated area of 41.45 million M<sup>2</sup>. These cogeneration power plants have 1,015 heat exchange stations and provide 897 t/h of steam to 105 industries.

At the end of 1998, 286 cities, or 42.81% of the total, were equipped with heating facilities that included 34,308 km of pipeline: 6933 km of steam pipeline and 27,375 km of hot water pipeline. The steam supply capacity at the end of 1998 was 66,427 t/h; and hot water: 71,720 MW/h; or steam 174.63 million ton/year, hot water  $6.47 \times 10^7$  GJ/year. The total heating areas in the nation in 1998

were 865.4 million M<sup>2</sup>. Currently, the heating area in Beijing is 64.11 million M<sup>2</sup>. The percent of actual heating areas is 34.6%.

Cogeneration power plants provide 62.9% of the entire steam supply, while boilers and individual coal-fired facilities provide 35.75% and 1.35% respectively. However, demand for heat in urban areas is increasing very rapidly. Among the entire heating areas in the nation, the heating areas for commercial buildings are 33.12%, residential and individual areas are 59.76% and 7.11% respectively. The heating supply for urban residents has the following characteristics: (a). The heat supply in the northern part of China, including Beijing, Shandong, Hebei and Northeast China, is mainly residential. (b). The heating supply in south part of China, including Shanghai, Jiangsu, Zhejiang and Anhui, is mainly commercial and industrial. But, as time goes on, an increasing number of residential areas in the south will be supplied with heat as well.

#### (iv). Urban Steam Pipelines

In 1995, the length of urban underground steam pipeline was 9,251 km or 29% of the total length.

Underground hot water pipelines has already had the national standard that applies for the median temperature less than or equal to 150 °C. The hot water pipeline is made of steel installed with a thermal-insulating layer.

Hundreds of kilometers of underground steam pipelines have been constructed in more than 10 cities. The largest diameter of these currently being tested is DN700mm.

The cities in northeast China, north China and northwest China lay mainly drain and underground pipelines.

The cities in south China build mainly on-ground pipelines.

## II. Potential Market of China's Cogeneration

China's has 40 years' experiences with cogeneration and has already developed its cogeneration capacity on a considerable scale. However, the current status is far from satisfactory for the needs. China's cogeneration has following potentials.

### (i). The Need for Energy Saving

China is not only a big coal producer; it is also a big coal consumer. At present, coal is still the major fuel for the country. China's increasing economic development has a concurrent increase in demand for energy. In the past, energy production and consumption were basically in balance, but since 1993, China has begun to import energy. According to estimates, the shortage of energy in China will become more serious in the future. Even if China adopts advanced technology to efficiently utilize energy, to speed up exploration and usage of renewable energy and to optimize the allocation of energy resources by relying on market regulation, by 2010 and 2040 the energy shortage in China will be 8% and 24% respectively.

More and more Chinese people aware of that combined heat and power production can effectively save energy. The central government has decided that the development of energy should

take precedence. With the support of government, energy development in China has great potential.

(ii). Opportunity of Energy Restructuring

Presently, China seeks to strategically develop its energy resources. Modernization will require regulating energy development, optimizing the energy structure, raising energy efficiency, making long-term energy saving plans, systematically replacing inefficient equipment, and breaking down the habit of relying only on domestic energy sources. We should establish and internationalize a long term and multi-energy supply system to optimize the utilization of energy resources. The development of natural gas should be considered as the focal point for the next century.

In 1998, there were 115 gas turbines in excess of 0.6 MW each, with a total capacity of 4600 MW. Of these, only a few were used as cogeneration power plants. Currently, the central government is considering restructuring the energy system to improve efficiency and reduce air pollution. Developing cogenerating natural gas turbines has attracted the government's attention. The "Regulation on Combined Heat and Power" was issued recently in which it specially proposed the development of gas and steam combined cycle technology.

It is reported that Tianjin City is planning to install a 300 MW gas turbine combined cycle generator. It is predicted that natural gas as a fuel source, and a steam turbine combined cycle cogeneration technology will be added in the near future.

(iii). Natural Gas Used in Cogeneration Project

Beijing is ranked as the second most polluted city in the world. The Chinese central government and Beijing Municipal

government consider air pollution to be an important issue that needs to be administrated immediately. A series of policies have been made that would reduce the number of polluting coal-fired boilers in the city. Beijing Blue Sky Natural Gas Cogeneration Project is an example of a project that follows the current policies. The Project is to use natural gas already available in Beijing to rebuild several existing coal-fired heating plants into clean energy cogeneration power plants, which will not only help to improve Beijing's air quality but will also reduce the shortage of electricity and secure the safety of power grid. The project is currently being developed by Eastern Energy Investment Co., a subsidiary of CITIC, the biggest investment and trust company in China, Beijing Gas Group and Beijing Capital Group.

(iv) Environmental Protection Criteria

Coal accounts for about 75% of fuel use in China, and its emissions cause severe air pollution.

Because of the fast development of township enterprises, environmental pollution has become a more serious problem elsewhere as well. With the improvement in people's living standards has come a greater desire to protect their living environment. Both urban and rural communities urge the government to get rid of the polluting coal-fired boilers and to change to clean energy. In 1998, 322 cities participated in an environmental survey. Of the cities, only 89, or 27.6%, met national environmental standards. Ninety-three cities, 28.9% were below standard, while 140 cities, 43.5% were severely polluted. Therefore, many cities are now seeking ways to improve air quality. Principal among these are Beijing, Guangzhou, Shanghai, Taiyuan and Tianjin. Combining the production of heat and power is one of the most effective ways to lowering pollution. Therefore, some of cities have built



cogeneration power plants simply in order to improving their air quality.

(v). Industrial Demand

In 1998, the production of coal in the country was 1.25 billion tons, crude oil was 161 million tons and natural gas was 22.3 billion M<sup>3</sup>. The total consumption of standard coal for generating electricity in the same year was 347.32 million tons, for heating it was 41.84 million tons. Coal consumption for generating electricity and providing heat was only 31.13% of the total production. According to the report, most coal consumption in 1998 for the production of building materials and other industries. Coal used in electricity generation, refining, transportation and residential heating accounted for 40% of consumption. Thus, the ratio of converting first energy to electric power was too low and first energy was enormously wasted. According to estimates, in 1998, there were 506,500 coal-fired boilers in the nation of which steam boilers numbered 340,700, or 67.27%, and hot water boilers numbered 165,800, or 32.73%. According to the boilers' function, there were 263,400 boilers used for residential heat, or 52%, and 237,800 were used for production, while, the number of boilers used for generating electricity was only 5,286, or 1.05% of total. As can be surmised, there are many areas with available clean energy and the right conditions to use cogeneration technology that are still using coal-fired boilers, which cause severe air pollution.

(vi). Increasing Demand of Residents

At the end of 1997, 12.24% of residential areas had centralized heating. In the north, northeast, and northwest, the percent was 29.08%. According to the plans of the China's Construction Ministry, 15% of residential areas will have

centralized heat by 2000. In economically developed cities, the percent will be between 45% and 50%.

In recent years, with the rise in people's living standards, many cities that originally did not have heating facilities will now be equipped with new buildings that are heated regionally. The heating areas are being expanded from north to south. With increasing demand for heating there will be a concurrent demand for cogeneration plants.

(vii). Township Small Cogeneration Development

The rural areas continue to be the most important aspects in the nation's social and economic development. In order to realize modernization targets by the middle of 21<sup>st</sup> century, the key issue is to urbanize, industrialize and modernize the rural areas. According to research, by the middle of 21<sup>st</sup> century, about 600 million of farmers will have migrated to urban areas. The migration of farmers will greatly increase the demand for commercial energy. Presently, there are more than 1 million township enterprises in 500,000 counties requiring a great deal of electricity and steam. Therefore, rural areas will soon be a big market for cogeneration.

(viii) Government Support

In order to more effectively save energy, protect the environment and ease the shortage of electricity, both central and local governmental agencies have made a series of policies actively encouraging and supporting combined heat and power technology.

### III. Conclusion

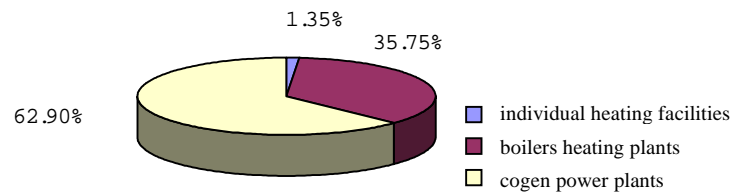
According to the analysis, we consider that China has extensive prospects for increased cogeneration. China's future cogeneration development will demand large capacity and high efficiency cogeneration units, which will also promote the development of gas and steam turbine combined cycle cogeneration technology. It is estimated that China will add about 3,000 MW units of cogeneration each year.

Currently, two factors restrict the development of China's cogeneration. (i) There is a lack of technical know-how that requires us to learn from and cooperate with advanced countries. (ii). There is a shortage of funding that requires us to attract international investment. In developing cogeneration in China, we hope to be your best partners and friends.

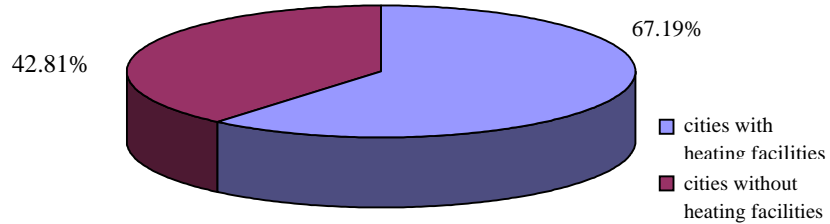
China Electric Generation Association was founded in 1934 and has branches in various provinces, cities and autonomous regions, including a branch in the United Kingdom. There are 33 subsidiaries under this association including the "Cogeneration Study Committee for Chinese Society" which is researching Chinese cogeneration. Currently, there are 480 memberships throughout China. Some of the leaders in this committee come from the central government and cogeneration related governmental agencies. The memberships come from various cogeneration power plants, cogeneration equipment manufacturers, and cogeneration design and research institutes. The committee also seeks to gather experts in cogeneration technology. We are glad to establish and extend contact and relationships with international groups and friends, to cooperate and exchange experiences, and to jointly promote the development of cogeneration technology.

We wish everyone the best in achieving great advances in cogeneration technology, and we look forward to a bright future of cooperation and development.

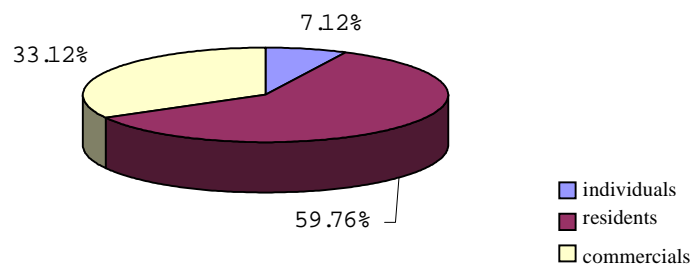
**Proportion of Various Heating Plants  
in Urban Area of China**



**Cities with Heating Facilities in China**



**Heating Areas in China**



# China's Cogeneration Existing Status & Potential Market

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
4688.00	4915.00	5482.00	6006.00	6498.00	7302.20	8168.00	8841.95	9950.00	11121.00	12209.00	1394.00	15119.00	16053.00	18120.00	19642.00
491.00	513.83	535.01	592.04	623.64	759.48	848.93	998.93	1212.33	1340.00	1465.10	1551.50	1724.00	1902.00	2197.10	2493.85
270	282	299	334	351	393	486	538	609	671	723	789	898	999	1229	1313
23.20	22.86	21.14	57.03	31.60	135.83	89.45	149.99	213.40	127.87	124.90	86.40	172.90	178.00	295.00	269.75
10.47	10.45	9.76	9.87	9.60	10.40	10.39	11.29	12.18	12.05	12.00	11.13	11.40	11.85	12.12	12.70
				668.00	761.00	808.00	927.00	1041.00	1353.00	1550.00	1689.00	1852.00	2047.00	2222.22	
					93.00	47.00	110.00	114.00	312.00	197.00	139.00	163.00	195.00	175.20	











